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(54) TWO SPEED SINGLE OUTPUT GEARBOX

(71) We, ETAT FRANCAIS, represented by the Minister of the Armed Forces, the Ministerial Delegation for Armaments, of 10 Rue Saint-Dominique, Paris 7e, France,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a two speed single output gearbox. The gearbox is intended primarily for connecting a drive source to a sprocket wheel of a tracked vehicle.

According to the present invention, there is provided a two speed single output gearbox comprising an epicyclic gear train having a sun gear, an annulus gear, carrier carrying planet gears and an output shaft from said gear train; and a drive engaging means for connecting a drive source of said gear train; said drive engaging means including coupling means for coupling said drive source to one member selected from the annulus gear, sun gear and said carrier, to impart rotation thereto while constraining against rotation a second member selected from the annulus gear, sun gear and the carrier, the third member selected from the annulus gear, sun gear and carrier carrying said output shaft, which coupling means is adapted for switching the coupling of said first and second members with said drive engaging means, and the coupling means includes a coupling member secured for rotation with but movable axially of said first member and another coupling member secured for rotation with but movable axially of said second member, said coupling members being independently rotatable and connected together for axial movement, the drive engaging means further comprising a drive pinion adapted to be connected to the drive source and a toothed wheel driven, in use, by the pinion and engageable with either of the coupling members, there being a reduction ratio, in use, between the speed of the pinion and the speed of the toothed wheel.

In the preferred embodiment said one member is the sun gear and said second member is the annulus gear.

The coupling members may be movable to an axial position where said toothed wheel is no longer connected to either of the coupling members and hence said gear train so that the output shaft of said gear train can freewheel. The coupling members may be splined to shafts extending from their respective said members selected from the sun gears, annular gear and carrier. The third said member can be splined to the output shaft.

The coupling members may comprise dogs which are adapted to engage with co-operating dogs on the driven toothed wheel or on a fixed frame, depending on the axial portions of the coupling members.

Hydraulic means may be provided for effecting axial movement of said coupling members. Alternatively pneumatic, mechanical or electrical means can be provided for this purpose.

Also included within the scope of the invention is a tracked vehicle having a gearbox as set out above.

For a better understanding of the invention and to show more clearly how the same may be carried into effect, reference will now be made, merely by way of example, to the accompanying drawing which shows a sectional view of a two-speed single output gearbox in accordance with the present invention.

The gearbox shown comprises two sections A and B. The first section A is a drive engaging means in the form of a clutch and the second section B is an epicyclic gear train. The clutch includes a drive pinion 1 which is secured for rotation on a splined shaft 1*a* of a driving gear 1*b* of a drive source (not shown). A brake 1*c* engageable with the shaft 1*a* is provided. An externally toothed wheel 2 meshes with the pinion 1 for producing a first speed reduction R as described hereinafter. The wheel 2 comprises, at an inner periphery thereof, an annular section *a* having two sets of radially inwardly directed dogs *b* and *c*. The sets of dogs *b* and *c* are identical in form.

A fixed frame 5 which has two sets of radially inwardly directed dogs *f* and *g* identical with those of wheel 2 is mounted so that the sets of dogs *f* and *g* lie on circles having the same diameter and centres lying on the same axis as the circles on which lie the sets of dogs *b* and *c*. The circles on which dogs *f* and *g* lie being axially outward of the circles on which dogs *b* and *c* lie, dogs *g* being adjacent dogs *c* and dogs *f* being adjacent dogs *b*. The clutch is provided with two annular coupling members 3 and 4. Coupling members 3 and 4 are axially displaceable thus allowing variations to be made in the coupling of the epicyclic gear train's sun gear 7 and annulus gear 6 as will be explained below.

The annulus gear 6 is internally toothed and provided with a hollow splined drive shaft *d*. The sun wheel 7 is also provided with a splined drive shaft *e* (this shaft extends within the shaft *d* of the annulus gear 6). Three planet wheels, of which only two 8 and 9 are shown are mounted between the annulus and the sun wheel and are connected by a carrier 11 to a splined shaft *h*. A sprocket wheel carrying plate 12 has a splined shaft *j* which co-operates with shaft *h* to secure the carrier 11 for rotation with the plate 12. A sprocket wheel 13 having track engaging teeth is mounted on the plate 12.

Coupling member 3 is provided with splines which co-operate with the splined drive shaft *d* of the annulus gear 6 so that the member 3 is secured for rotation with the drive shaft *d* and is able to move axially thereon. Similarly coupling member 4 is provided with splines which co-operate with the splined drive shaft *e* of the sun gear 7 so that member 4 is secured for rotation with the drive shaft *e* and is able to move axially thereon. Members 3 and 4 are provided with radially outwardly extending dogs arranged to co-operate with dogs *f* and *b*, and *g* and *c* respectively. The members 3 and 4 are secured together for axial movement but are free to rotate independently of one another. Axial movement of the members 3 and 4 is effected by a hydraulic system 16 which enables smooth engagement of the members with the wheel 2. However, alternatively, this axial movement could be effected pneumatically, mechanically or electrically.

By axially moving the members 3 and 4 relative to the dogs *b* and *c* of the toothed wheel 2 and *f* and *g* of the frame 5 three coupling positions may be selected.

Movement of the members 3 and 4 to the right, as viewed, causes the dogs of member 3 to engage the dogs *f* of the frame 5 and the dogs of member 4 to engage the dogs *c* of the toothed wheel 2.

Movement of the members 3 and 4 to the left as viewed, causes the dogs of member 4 to engage the dogs *g* of the frame 5 and the dogs of member 3 to engage the dogs *b* of the toothed wheel 2.

Movement of the members 3 and 4 to the position shown in the drawing causes disengagement between the dogs of the members 3 and 4 and the toothed wheel 2 and the frame 5.

The operation of the gearbox will now be explained. The drive pinion 1 is rotated by the shaft 1*a* extending from the drive source and drives the toothed wheel 2.

High-speed rotation of the sprocket wheel 13 is obtained by immobilising the sun gear 7. The members 3 and 4 are axially moved to the left as viewed so that the dogs on member 4 engage with the dogs *g* of the fixed frame 5, the member 4 is therefore prevented from rotating as is the shaft *e* of the sun gear 7 and the sun gear 7 itself. With the member 4 in this position, as explained above the dogs of the member 3 are engaged with the dogs *b* of the toothed wheel 2. Consequently the wheel 2 rotates member 3 and thus the shaft *d* of the annulus gear 6 which rotates the planet wheels. The planet wheels cause the carrier 11 to rotate. The arms 11 then produce the rotation of the sprocket wheel 13. Between the rotation of the annulus gear 6 and the carrier arms 11 there is a second transmission ratio R_1 and consequently a final reduction R^1 is obtained ($R^1 = R.R._1$).

Thus, rotation of the drive pinion 1 produces rotation of the sprocket wheel 13 through the toothed wheel 2 and the epicyclic gear train B the sun gear 7 of which is, in this case, prevented from rotating.

Low-speed rotation of the sprocket wheel is obtained by preventing the annular gear 6 from rotating.

The drive pinion 1 and the toothed wheel 2 are driven as before, affording the same reduction ratio R.

By axial movement of the member 3 and 4 to the right, as viewed the dogs of member 4 engage with the dogs *c* of the toothed wheel 2, thus producing rotation of the member 4, the shaft *e* and the sun gear 7. As explained above this movement causes the dogs of member 3 to engage the dogs *f* of the fixed frame 5 thus preventing the rotation of the shaft *d* and the annulus gear 6. Thus, rotation of the wheel 2 produces rotation of the member 4 and consequently of the sun gear 7 which, in turn, sets in motion the planet wheels and also the carrier 11 and the sprocket wheel 13.

In this case, the epicyclic gear train provides a second reduction ratio R_2. Thus, between the drive pinion 1 and the sprocket wheel 13 there is the final ratio R^{11}, ($R^{11} = R \times R_2$).

Movement of the members 3 and 4 to the position shown in the drawing enables the sprocket wheel 13 to freewheel. The toothed

wheel 2 may be immobilised due to an accident (box, engine, etc.). If the members 3 and 4 are put into this position which is intermediate relative to the two preceding positions they are disengaged from the toothed wheel 2. Thus on the vehicle being pulled by an external means, the sprocket wheel 13 is able to rotate idly since the dogs of members 3 and 4 and the reducing gear thereof are disengaged. This feature is particularly useful if due to any accident to the gearbox or drive source the toothed wheel 2 is rotated or immobilised.

It will be appreciated that the gearbox permits two reduction ratios and also the freewheeling of the sprocket wheel 13, i.e. the declutching of the reducing gear. Furthermore, the compact arrangement made possible by the positioning of the parts of the gearbox enables simple and robust construction which is space saving.

WHAT WE CLAIM IS:—

1. A two speed single output gearbox comprising an epicyclic gear train having a sun gear, an annulus gear, carrier carrying planet gears and an output shaft from said gear train; and a drive engaging means for connecting a drive source to said gear train; said drive engaging means including coupling means for coupling said drive source to one member selected from the annulus gear, sun gear and said carrier, to impart rotation thereto while constraining against rotation a second member selected from the annulus gear, sun gear and the carrier, the third member selected from the annulus gear, sun gear and carrier carrying said output shaft, which coupling means is adapted for switching the coupling or said first and second members with said drive engaging means, and the coupling means includes a coupling member secured for rotation with but movable axially of said first member and another coupling member secured for rotation with but movable axially of said second member, said coupling members being independently rotatable and connected together for axial movement, the drive engaging means further comprising a drive pinion adapted to be connected to the drive source and a toothed wheel driven, in use, by the pinion and engageable with either of the coupling members, there being a reduction ratio, in use, between the speed of the pinion and the speed of the toothed wheel.

2. A gearbox as claimed in claim 1, in which said first and second members are the sun gear and the annulus gear.

3. A gearbox as claimed in claim 1 or 2, wherein said toothed wheel is adapted to become disengaged from both said first and second members to allow the drive source to be disconnected from the gear train so that the output shaft of said gear train can freewheel.

4. A gearbox as claimed in claim 3 wherein said toothed wheel is adapted to become disengaged from both said first and second members when the coupling members are axially displaced to a predetermined position.

5. A gearbox as claimed in any one of the preceding claims in which the coupling means further comprises two shafts to which are splined said coupling members and on which are mounted said first and second members.

6. An arrangement as claimed in any one of the preceding claims in which said third member is splined to said output shaft.

7. A gearbox as claimed in any one of the preceding claims in which the coupling members comprise dogs which are adapted to selectively engage with co-operating dogs on the driven toothed wheel or on a fixed frame depending on the axial position of the coupling members.

8. A gearbox as claimed in claim 1 wherein hydraulic means is provided for effecting axial displacement of said coupling members.

9. A gearbox as claimed in claim 1 wherein pneumatic, mechanical or electrical means is provided for effecting axial displacement of said coupling members.

10. A gearbox as cliamed in any one of the preceding claims, wherein the output shaft is engaged with a sprocket wheel of a tracked vehicle.

11. A two speed-single output gearbox substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.

12. A tracked vehicle provided with a gearbox as claimed in any preceding claim.

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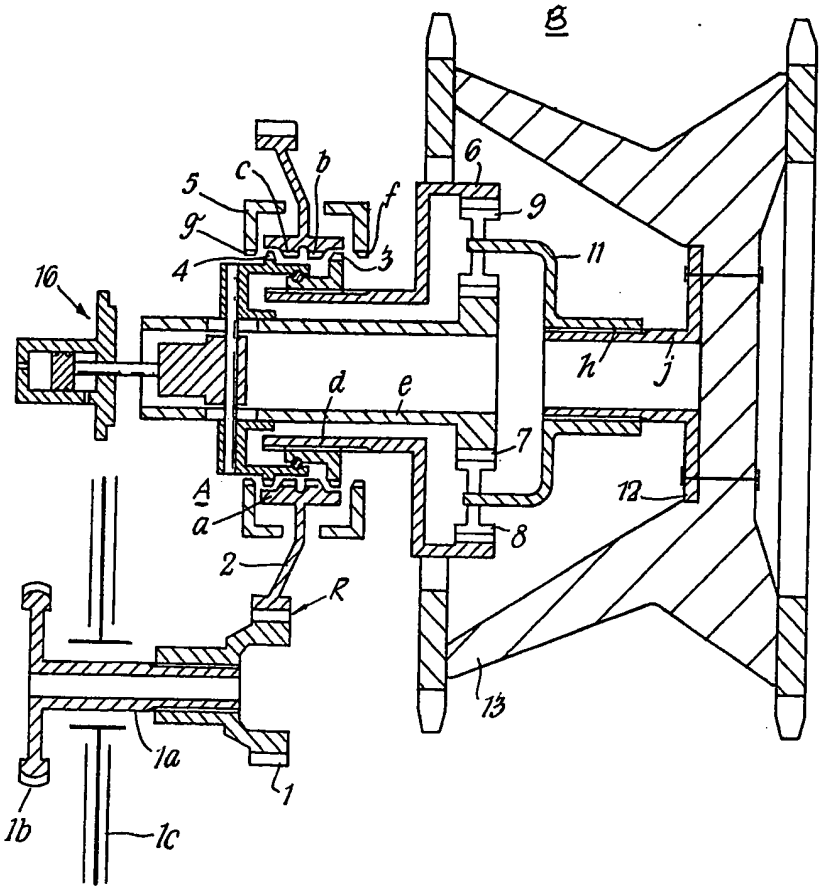
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